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A Study of the Physiologic and Pathologic Changes Occurring in the Reproductive Organs of the Cow Following Parturition

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UNIVERSITY FARM, ST. PAUL

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A STUDY OF THE PHYSIOLOGIC AND PATHOLOGIC CHANGES OCCURING IN THE REPRODUCTIVE ORGANS OF THE COW FOLLOWING PARTURITION

By W. L. Boyd

INTRODUCTION

In pursuance of studies on the subject of sterility in cattle, data are being collected on the various changes which occur in the reproductive organs following parturition. Special attention is being given to the different processes involved in involution and subinvolution of the uterus.

The animals from which data were collected were with few exceptions purebred cows owned by the University. This made possible frequent and in many cases daily examinations. Treatment was not applied to cows which calved normally, unless symptoms of infection appeared during the process of involution. Cows affected with metritis, retention of the fetal membranes, trauma, or other diseased conditions frequently occurring incident to parturition, were given medical and surgical aid in order to preserve the reproductive powers. In cases in which the corpus luteum failed to undergo degeneration and thereby prevented renewed ovulation, the corpus luteum was removed in order to maintain at as high a point as possible, the breeding efficiency of the herds. The amount of time required for the completion of involution varies considerably, depending largely upon the condition of the reproductive organs at the time of parturition. Cows which gave birth to strong vigorous calves and promptly expelled the fetal membranes, seldom suffered with infections which would retard involution.

The uterus rapidly diminished in size and in many instances could be described as having returned to its normal non-gravid shape and position within from twelve to fourteen days; in other cows, in which there was mild infection, three weeks was required. Cows that retained the fetal membranes as a result of the Bang organism or other bacteria capable of producing similar lesions, together with secondary invaders, very often required from thirty to sixty days.

CHANGES OCCURRING IN THE VAGINA

The vagina after parturition will often present a bruised edematous, hemorrhagic, and in certain cases of dystokia, lacerated appearance. The vagina as a rule quickly regains its muscular tonicity. The extravasated blood is absorbed in a week or ten days and unless there is extensive laceration with necrosis of the mucous membrane, the wounded areas are soon repaired. If the vagina is severely injured, necrosis usually follows. This often permits the invading bacteria to enter into the fibrous coat and even into the pelvic cavity, producing peri- and para-metritis with or without abscess formation. The vulva frequently contains blood suffusions, is edematous, and occasionally lacerated. This structure regains its normal tone in a few days. Cervicitis is of common occurrence following parturition and frequently inhibits involution, and if tissue damage is extensive the reproductive power of the animal may be destroyed.

HYPERTROPHY OF THE VAGINAL WALLS

This is frequently seen during the late stages of gestation, following parturition, and occasionally in unbred heifers. The wall of the vagina, 10 to 12 cm. anterior to the vulva, laterally and dorsally, becomes hyperplastic so that partial collapse of the vagina results, ordinarily seen only while the animal is recumbent. Severe inflammatory changes in the post-parturient animal sometimes develop and result in more complete prolapse, induced by straining from the irritation. The condition is ordinarily successfully treated through surgical removal of the hyperplastic portion of the wall and the accumulated fat tissue in the pelvic cavity in close proximity to the fibrous coat of the vagina.

Prolapse of the vagina is seen in cases other than from the development of hypertrophic walls. It is occasioned by advanced pregnancy, especially in fleshy animals, and from injuries following parturition. The prolapse is frequently not complete, and is visible only while the animal is lying down, but may be severe and complete.

CHANGES IN THE OS UTERI

The cervical canal closes very rapidly following parturition, the act being especially rapid when the fetal membranes are promptly discharged. Following normal calving, the cervix, within 10 or 12 hours will have contracted to the extent that there will be some difficulty in passing the hand through the canal into the uterine cavity. In cases of retained fetal membranes, contraction of the cervix is less

rapid, particularly if some of the membranes are in and protruding beyond the canal. The cervix is frequently more or less lacerated, hyperemic, hemorrhagic, and edematous. The mucous plug of pregnancy which gives way at the beginning of parturition, clings tenaciously to the walls of the canal and small portions of it will often be found attached for twenty-four to thirty-six hours after parturition.

ACTION OF THE UTERUS FOLLOWING PARTURITION

The changes occurring in the uterus after parturition are physiologic, but they are close to the border line of pathology, and if they occurred elsewhere in the animal body they would be considered as pathologic. This explains the frequency and severity of infections if certain bacteria invade the uterine cavity. The rapid diminution of the uterus is brought about by absorption of the tissue juices and certain changes in the muscle fibers. Some authorities believe that the muscle cells undergo fatty changes, while others do not. Compression of the uterine blood vessels by the contraction of the uterus results in anemia, which permits of the changes mentioned. DeLee (3) in describing the changes occurring in the uterus of the human, states that thrombosis occurs in the walls of the deeper veins only in pathologic cases, but a superficial thrombosis is not abnormal. In one of the experimental animals which suffered with severe metroperitonitis, extensive thrombosis of the middle uterine artery was encountered. The affected vessel was without difficulty palpated by way of the rectum. In another animal an aneurism of the middle uterine artery was discovered.

Knowledge of the changes involving the uterine mucous membrane is very meager, but there is no doubt that these changes are less rapid than the changes occurring in the musculature of the organ. It seems quite probable that cows which .calve normally in every respect and which receive proper care and feed during their post-parturient stage, seldom complete all the processes involved in involution inside of thirty days.

RELATION OF THE PLACENTA TO INVOLUTION

The placenta of the cow is poly-cotyledonary in type and the arrangement is so complicated that it is not so easily detached or so readily expelled as in animals whose placenta is diffuse. Following the expulsion of the fetus and fetal fluids, the lumen of the uterus materially decreases, the muscles of the uterine walls contract, and the cervix decreases in vascularity and rapidly contracts. The cervical canal is very frequently approximately closed from 12 to 24 hours

after parturition. The fetal membranes are as a rule expelled within from 4 to 6 hours. In a small percentage of cases they will be expelled in 2 or 3 hours, and not infrequently they will remain attached for 7 or 8 hours even tho there is no inflammation. When the fetal membranes are retained for more than 10 or 12 hours, it is quite evident that placentitis is present, and they will have to be removed manually or allowed to remain in the uterus to undergo putrefaction, being finally expelled as a putrid mass, consisting mainly of fluid, pieces of the membranes, and tissue debris. The separation of the fetal and maternal placenta is the result of cessation of the fetal circulation which permits the falling away of the chorionic villi from the crypts of the cotyledons. The expulsion of the membranes is effected by their weight and the muscular contractions of the uterus. As stated by De Bruin (1) the numerous placentae of the cow do not separate from the uterus simultaneously, but one after the other. In experimental animals, immediately after calving, there was often much difficulty in obtaining enough placental attachments for bacteriologic and pathologic study, yet the entire fetal membranes of these animals were frequently expelled 4 or 5 hours later. In normal separation of the fetal membranes, severe hemorrhages are only rarely observed in large animals. Retention of the fetal membranes as a result of placentitis seriously interferes with regression of the uterus, through interference with muscular contraction, which brings about uterine inertia. Inertia of the uterus also may be present before or at the time of parturition. Placentitis is a common symptom of bovine infectious abortion and according to the work of Theobald Smith (2) *Bacterium abortus* Bang has a predilection for the chorionic epithelium. On the other hand, several experimental animals suffered with retained afterbirth in which the Bang bacillus could not be isolated from the placenta or from guinea pigs inoculated with suspensions of it. The blood of these cows was also negative to both the agglutination and complement fixation tests. The reduction of the uterus is subject to many variations. Inflammation of the placenta, if at all extensive, means retained fetal membranes. This invites sepsis and results in retarding or stopping involution. Involution, however, acts as a barrier to infection and it is a well established fact that the uterus which has good muscle tone and contracts rapidly, seldom absorbs bacteria or their toxins.

APPEARANCE OF THE LOCHIA

One of the striking events in the puerperium is the appearance of the lochia. Lochia may be defined as the uterine, cervical, and vaginal discharges which follow for several days after the expulsion of the

fetus. The lochia consists of a serosanguineous exudate, at first red, but soon becoming brown and then clear owing to the appearance of mucus which may at times contain particles of pus and tissue debris, giving the lochia a cloudy appearance. If not evacuated successfully, the lochia may form a favorable medium for the development of bacteria. Cases are met with in which particles of the placenta have been retained and in which the cervix closes so rapidly that the uterus can not evacuate its contents. The nature and appearance of the discharge is an important guide to the condition and progress of the patient. A thin, watery, reddish brown, malodorous discharge signifies danger and means that the uterus is undergoing inflammation and is not contracting because of lack of muscle tone brought about by the infective agents. This condition permits the absorption of bacterial products which causes elevation of temperature and not infrequently enteritis, which is evidenced by a copious watery diarrhea. Mastitis is also a common complication. In severe cases terminal pneumonia is not uncommon. These conditions are most common in cases in which the fetal membranes have been wholly or partially retained, but may occur in cows in which the membranes are entirely expelled. Cows that experience normal parturition will in almost every instance have an abundance of clear mucus resembling the mucous discharge of estrum in the vagina and cervical canal. This phenomenon appears early preceding the serosanguineous discharge of lochia.

PYOMETRA

Involution is frequently retarded or stopped by a suppurative inflammation of the uterus called pyometra. Pyometra is a condition of the uterus in which there are chronic inflammatory changes of the uterine mucosa characterized by sacculation of one or both of the horns and flaccid muscular walls, with little or no contractile power, owing to a loss of muscle tone. The uterus is asymetrical, abdominal in position, and one or both horns are partially filled or distended with pus. The cervix is inflamed and more or less dilated. This pathologic condition occurs most often in cows which have suffered with retention of the fetal membranes, but is known to occur when the membranes were promptly discharged after calving. In working with the bacterial flora of this condition, *Bacillus pyogenes* has been isolated in a large majority of cases. This is apparently the predominating organism in these types of infection.

The history of pyometra is usually as follows: The owner or herdsman in describing these cases states that the affected animal has not been in estrum since calving, and that a small pool of pus is usually

found back of her when she is lying down. They also notice that there is more or less staining of the lips of the vulva, and collection of pus on the under surface of the tail. Cows suffering with pyometra are frequently allowed to go for six or seven months before the services of a veterinarian are employed. The treatment of pyometra, unless begun early, is often unsatisfactory, because even tho the uterus successfully completes the delayed involution and estrum is regularly established, regeneration of the mucous membrane is slow or the membrane has been destroyed or replaced by other types of epithelium. The change in epithelium interferes with or prevents attachment of the fertilized ovum; in cases in which the ovum does become imbedded, early abortions are frequent.

In cows that have had the disease only a short time, the corpus luteum will frequently be found projecting above the surface of the ovary, but in long-standing cases the yellow body will be found to be more centrally located and therefore more difficult to remove. The dislodgment of the corpus luteum in entirety is usually tho not always responsible for rapid changes in the uterus. Not only does the uterus promptly discharge its contents through the re-established muscle tone, but it also changes rapidly morphologically, regaining its symmetry and normal anatomical position within a very short time. In cases in which only a remnant of the corpus luteum is present, treatment is less successful. Estrum frequently tho not regularly appears within five days after the corpus luteum is enucleated, especially if tissue destruction has not been extensive.

CHANGES OCCURRING IN THE OVARIES

Apart from the changes occurring in the ovaries which result in the degeneration of the corpus luteum, few changes can be recognized.

Cystic degeneration of one or both ovaries within a few days after parturition has been found in several cases. The etiology of these changes has not been fully determined. In certain cases they possibly result from ascending infections, while in others the origin of the infective agent may be hematogenous. With few exceptions the described changes have been observed in purebred cattle, some of which had been conditioned for show purposes, while others were highly fed for the purpose of establishing records in milk and butterfat production. Cows which had not been prepared for either show or official testing, were found in which cystic degeneration had affected the ovaries. But in all instances, these animals had been receiving a liberal diet rich in protein. The relation of the diet to cystic degeneration is interesting and suggestive, but the lack of experimental

work in this field makes it impossible to form definite opinions. Cystic changes of the ovaries, if extensive, retard involution. The uterus will regress to approximately its normal size and position, but it remains soft or flaccid, on account of failure to regain normal muscle tone. Mild inflammatory changes affecting the mucous membrane of the cervix and uterus frequently co-exist with cystic changes of the ovary.

THE CORPUS LUTEUM

The corpus luteum of pregnancy remains throughout the gestation period and from one to two months after its termination. The corpus luteum occasionally will disappear earlier than 30 days after parturition, again it will quite frequently remain for 90 days or longer. In a very large percentage of cases in which the corpus luteum persists following calving, ovulation is inhibited and the re-establishment of estrum is delayed until the corpus luteum has undergone denegeration. The relation of the corpus luteum to involution is not known, but according to Smith's Manual of Veterinary Physiology (4) the corpus luteum is suspected of secreting a hormone which aids in regression of the uterus. These various phenomena constitute the function of involution. In cows which calve normally and expel the fetal membranes promptly, regression of the uterus is quite rapid. In many such cases, the uterus will contract so rapidly that the entire organ may be placed in the palm of one's hand in 8 to 10 days after parturition. The changes in the uterine mucosa of these cows are very probably under the most favorable conditions not completed until 30 to 40 days after the termination of gestation. If the uterus is invaded with micro-organisms, both before and following the termination of the gestation period, sub-involution frequently results, and from 3 to 4 weeks will have elapsed before the uterus has regained its normal non-gravid shape, position, and muscular tonicity.

The mucous membrane of the uterus and cervix in such cases requires additional time to complete involution, as is evidenced by the discharge from the uterus of more or less mucopus which continues from 2 to 3 weeks or in certain cows may continue indefinitely, retarding or delaying involution.

BOVINE INFECTIOUS ABORTION

Infectious abortion is responsible for a very large percentage of retarded involution. Placentitis is in most instances undoubtedly due to the activities of the Bang organism, and retention of the fetal envelope is a forerunner of various disorders of the reproductive organs. Successful prevention of infectious abortion will markedly

reduce the percentage of sterility, but it will not control it entirely. That sub-involution of the uterus and subsequent sterility is not always related to the Bang bacillus has been clearly shown by the research of various workers in connection with infectious abortion and sterility.

Bacillus pyogenes, various types of streptococci and staphylococci, and certain types of the colon group are frequent invaders of the reproductive organs following parturition. This fact has been conclusively shown by numerous investigators. Extensive physical trauma as a result of dystokia or resulting in the removal of the fetal membranes or in the attempt to remove them when placentitis is pronounced, is in many cases followed by metroperitonitis with multiple abscess formation. In most cases only the outer coats of the reproductive organs are involved, altho the mucous coat is frequently affected, and in cases of ovarian affection the entire gland is often destroyed and converted into an abscess which may or may not be adherent to the surrounding tissues. The abscess walls are usually very heavy with occasional exceptions of those occurring in the ovary. Adhesions of the various organs are numerous, with extensive portions of the omentum being adherent in many cases through the attempt of nature to wall off the infection.

Among the animals studied were those which belonged to the experimental herd used for the investigation of abortion disease. Several of these cows were destroyed at short intervals following parturition and the reproductive organs were subjected to a bacteriopathologic study. The findings in cases in which the examinations have been completed are included.

The following observations are reported:

CASE NO. 1

Cow calved on September 21, 1922. Calf was normal. Fetal membranes were promptly expelled. On October 3, uterus had almost completed involution. A corpus luteum was present in the right ovary.

October 23, 1922, cow was re-examined and found to be normal, the uterus had undergone complete involution. Corpus luteum of pregnancy recently terminated, present in the right ovary.

November 18, 1922. The corpus luteum in the right ovary was removed.

November 22, 1922. Appeared in estrum and was bred.

January 17, 1923. In calf, the fetus being present in right uterine cornu.

May, 1923. Serological tests negative for *Bacterium abortus* infection. Second pregnancy terminated September 12, 1923.

September 14, 1923. An abundance of clear mucus in the vagina, and the cervix would allow entrance of two fingers. Uterus had good muscle tone. Left ovary was normal. Small degenerating corpus luteum was located in the right ovary. Uterine arteries were large, tortuous, and pulsating.

September 16, 1923. Upon examination, an abundance of mucus in the vagina was discovered. The cervical canal was almost closed, and the uterus was contracting rapidly. Uterine arteries were still large and pulsating.

September 25, 1923. Vaginal mucous membrane was normal. Cervix and cervical canal were normal. Abundant amount of clear mucus in vagina. Right horn of uterus slightly larger than left, but entire organ could be gathered into the hand and only mucus was given off when massaged. Blood vessels had receded to normal size and corpus luteum had almost disappeared from right ovary. A cyst was apparently forming in the left ovary. Muscle tone of the uterus was good. Involution in this cow was rapid.

September 28, 1923. Uterus was near normal in size and position. Muscle tone was normal as manifested by vigorous contractions of the uterus when massaged. The corpus luteum in right ovary was undergoing degenerative changes and was now very small. The vagina contained a large amount of clear mucus.

October 1, 1923. Approximately normal. Clear mucus was found in vagina and cervical canal.

October 5, 1923. Cow was now normal. Involution was complete.

October 15, 1923. Animal was in season, but not bred 33 days following parturition.

November, 1923. Serological tests negative for *Bacterium abortus* infection.

CASE NO. 2

Cow calved October 29, 1922. Retained fetal membranes, which were removed manually at the end of 24 hours. Metritis was severe and extensive.

October 31, 1922. Uterus was distended four or five times normal size, inflammation active. Right cornu was flaccid and adherent to broad ligament. Right ovary partly obscured in adhesions, perimetritis present, but well circumscribed.

November 4, 1922. Right ovary hidden in adhesions near and attached to apex of right uterine cornu. Abscess in right ovary. Pus in right uterine cornu caseated and filled lumen to the extent that the

walls were distended. Left ovary normal and left uterine cornu much improved, being twice the normal size. Cervicitis severe.

November 7, 1922. Extensive ovaritis and salpingitis with adhesions on right side. Right and left uterine cornua both greatly improved, but right horn somewhat distended with pus. Cervix much improved. Left ovary normal.

November 11, 1922. Uterus considerably improved. Abscess in right ovary large and adherent to the right uterine cornu and broad ligament. Left ovary normal. Cervicitis subsiding.

November 15, 1922. Abscess in right ovary greatly enlarged, approximately 12 cm. at its greatest diameter, circumscribed and adherent. Other organs improving gradually.

November 18, 1922. Condition of abscess affecting right ovary and right uterine cornu unchanged. Other organs improved. Small corpus luteum removed from left ovary.

November 28, 1922. Condition of abscess affecting right ovary and right cornu and tube, also broad ligament, unchanged.

December 16, 1922. Abscess of right ovary had increased in size, and involved the oviduct. Abscess punctured with horse trocar per vagina, and a small amount of sanious malodorous pus removed. Left ovary contained corpus luteum. Cornua of uterus normal. Abscess now pressed on bladder and caused periodical straining and frequent urination.

Serological tests positive for *Bacterium abortus* infection.

January 17, 1923. Examination revealed a large and extensive abscess involving the right ovary and oviduct, with massive adhesions. The uterus was adherent to broad ligaments, and it was difficult to outline the left ovary. Left ovary presented a condition similar to fibrosis, but was near normal in size. This cow was gaining in physical condition and there was little evidence of acute inflammation. She was slaughtered January 31, 1923.

AUTOPSY FINDINGS

On splitting open the carcass down the median line, it was noticed that there were marked and extensive adhesions in the region of the pelvis. The omental fat, rectum, uterus, ovaries, tubes, vagina, all were more or less adherent. As the paunch was pulled away, an abscess in region of right ovary was broken and the contents which poured out over intestines were semi-liquid with caseated particles. The pus was green in color and gave off a pungent offensive odor. All areas of inflammation were of a chronic nature. Parietal peritoneum on left abdominal wall shows 30 to 40 oval to circular button-like structures, the results of inflammation. These areas varied in size, from 5

to 10 mm. in diameter. There was an abundance of clear adhesive mucus in the vagina. The cervix was normal and free of adhesions. A large abscess 9 centimeters long and 6 centimeters wide was situated on the right side and attached to the dorsal surface of the vagina. The walls of the abscess were 5 to 10 mm. thick, and the pus varied in color from light gray to green. The pus near abscess wall was semi-fluid, while in the center it was caseated. The odor was pungent and offensive. A smaller abscess, 4 centimeters in diameter, was situated on inferior surface of bladder, the wall was thick, and the contents were semi-liquid and green in color. The right and left cornua, which were normal in size and appearance, were pulled sharply out of position to left of median line; they were adherent to broad ligaments and to the ovaries and oviducts. On incising the uterine cornua and viewing the mucosa, little or no evidence of inflammation was found, the carunculae were normal in appearance and size. A large irregular abscess 15 by 10 centimeters in diameter involved the right cornu, and was located at approximately 12 centimeters anterior to the bifurcation of the uterus. The abscess wall was 6 to 10 mm. across, the pus was malodorous, and varied in consistency from semi-liquid to caseous. Right ovary and oviduct were buried in adhesions and located only after careful dissection. Right ovary was normal in size, but presented a condition of fibrosis. No lutein tissue found, but one small cyst 5 mm. across and one other that may possibly have been a Graafian follicle were found. The right oviduct was enlarged to twice normal size and contained a catarrhal exudate. The left ovary and oviduct had undergone changes of cystic degeneration. The cyst was about 4 centimeters in diameter and the oviduct about the caliber of a lead pencil, with very thin walls. The fat next to the abscess formation was undergoing necrosis.

All lesions were cultured. None of them produced growths of *Bacterium abortus*. Luxuriant growths of *Bacillus pyogenes* were secured from all tissues in which there was suppurative inflammation.

CASE NO. 3

Cow calved October 10, 1922. Retained fetal membranes, which were removed manually on October 12.

Metritis, tho fairly extensive was not severe, but the discharge was quite copious. Temperature and appetite normal. Uterus possessed fairly good muscle tone. On October 16 uterus was irrigated with a normal saline solution and massage was applied. Right uterine cornu somewhat flaccid, but contracting gradually. Pus was becoming thicker and was yellow in color and somewhat malodorous.

October 31, 1922. Corpus luteum of recent pregnancy was present in right ovary. Uterus flaccid and enlarged to twice normal size. Slight pyometra. Contractions of the uterus stimulated by massage. Cervicitis was severe.

November 4, 1922. Right uterine cornu had better tone and was greatly reduced in caliber and length. Right ovary presented cystic corpus luteum. Uterus slightly flaccid, left cornu near normal, cervicitis severe with hypertrophy of external folds. Approximately 100 mils of creamy malodorous pus expelled upon application of massage.

November 7, 1922. Right ovary contained cystic corpus luteum which was not interfered with on account of extensive infection. Left uterine cornu about normal with good muscle tone. Right uterine cornu was reduced in size and not so flaccid. Approximately 50 mils of pus and mucus was discharged following massage. Uterus was irrigated with normal saline solution and then massaged.

November 14, 1922. General condition of the patient improving gradually. Cervix greatly improved.

November 18, 1922. Cervicitis still marked, uterus approximately normal. No discharge. Cystic corpus luteum removed from right ovary.

November 20, 1922. Small cyst was broken in right ovary. Corpus luteum was removed from left ovary. The corpus luteum was not located until today.

November 28, 1922. Cervix near normal. All other organs apparently normal.

December 16, 1922. Cyst in right ovary, approximate size 12 by 7 cm., was ruptured, small cyst of left ovary broken. This cow had not yet been in estrum. All other organs normal.

Bred on December 27, 1922.

Serological tests of the blood of this animal were positive for *Bacterium abortus* infection.

January 4, 1923. Corpus luteum in right ovary. No evidence of cystic formation in either ovary, cervix contains thick mucus, indicating continued presence of cervicitis.

February 23, 1923. Was in estrum. A remnant of the corpus luteum was located in right ovary. External ring of cervix was hypertrophied, but there was no evidence of acute inflammation.

February 13, 1923. In estrum and bred.

March 5, 1923. In estrum and again bred.

March 23, 1923. Cervicitis still quite extensive. Corpus luteum removed by compression from right ovary per vagina.

April 15, 1923. Cervix treated with Lugol's solution.

May 10, 1923. Treatment of cervix repeated.

May 24, 1923. Treatment of cervix repeated. Lugol's solution was used in every instance.

June 4, 1923. In estrum, cervix still slightly inflamed tho canal tightly closed. Right uterine cornu enlarged to four or five times normal size and filled with fluid. Condition resembled pregnancy. No corpus luteum in either ovary. Cervical canal dilated and an immediate escape of a thin reddish-brown fluid. This was all removed by massage, and then the uterus became ballooned with air which was removed by massage. It is possible that this cow had recently been pregnant. No signs of embryo or fetal membranes were found.

June 18, 1923. In season and bred.

Slaughtered July 3, 1923.

AUTOPSY FINDINGS

All organs were near normal except the external portion of the cervix, which was hypertrophied. The mucus membrane of the uterus was slightly congested and the carunculae were apparently somewhat enlarged. There was a corpus luteum in the left ovary. Cultures from cervix produced growth of *B. subtilis* and *Micrococcus pyogenes albus*. Cultures from the other organs remained sterile.

CASE NO. 4

Parturition occurred October 19, 1922. Dystokia, fetal and maternal, present. Calf removed by traction. Fetal membranes, retained, were removed on October 21, 1922. They were quite firmly attached, but had appearance of necrosis at placental attachments.

October 21, 1922. Uterus was contracting slowly and discharge was slight. Temperature and appetite were normal.

October 23, 1922. Uterus still greatly enlarged and actively inflamed. Left ovary normal. Unable to locate right ovary on account of perimetritis. Several pelvic abscesses in region of vagina and cervix. External cervical folds were inflamed and hypertrophied.

November 4, 1922. Uterus involuting fairly rapidly. Pelvic abscesses adherent to floor of pelvis and involving fibrous coat of vagina, were well walled in and the pus was caseated. Left ovary was normal. Cervix was greatly improved. Right ovary was still partly hidden on account of adhesions.

November 7, 1922. Abscesses in region of vagina unchanged. Uterus greatly improved, but twice normal size. Left ovary normal. Right ovary normal. Adhesions less marked. Corpus luteum had disappeared from right ovary. A scanty discharge of thick yellow pus was observed following uterine massage.

November 14, 1922. Abscesses were smaller and the general condition of the cow was much better.

November 18, 1922. A cystic left ovary was located and the cyst was ruptured. Condition of abscesses was unchanged.

November 28, 1922. All reproductive organs were apparently normal; the abscesses were smaller and three in number. They suggested the condition of fat necrosis. Those on the sides and below the vagina were flattened, with irregular surface and borders. The third, which was located partly above the vagina, was oval and the size was approximately 6 cm. in diameter.

Cow was bred on December 13, 1922.

December 16, 1922. A cystic corpus luteum was removed from the right ovary. All abscess formation with the exception of two small fibrous remnants had disappeared.

January 19, 1923. All signs of abscess formation had disappeared. Cervix normal. A second corpus luteum was removed from the right ovary. Instructions to herdsman were to breed the cow as soon as estrum appeared.

January 24, 1923. In estrum and bred.

March 23, 1923. Examined and found pregnant.

Serological tests of the blood were positive for *Bacterium abortus* infection.

This cow again gave birth to a bull calf during the night of October 9, 1923. The calf was strong and apparently normal. Blood samples collected from cow and calf at 10 a.m. October 10, 1923. At 1 p.m. an examination was made of the vagina, cervix, and uterus. The fetal membranes were still attached, with a small portion protruding through the cervical canal into the vagina. The uterus contained a large amount of thick grayish-brown but not malodorous exudate. Pregnancy had existed in left uterine cornu and the fetal membranes of right uterine cornu were not firmly attached. Placental attachments in part were necrosed, indurated, and the membranes were in places edematous. In securing placental attachments for animal inoculation purposes, it was discovered that the removal of the entire membranes could be accomplished. The uterus was irrigated with from 3 to 4 gallons of a mild antiseptic solution and the muscular contractions were found to be very rapid and strong. This was a badly infected cow according to clinical manifestations, and the placenta was the most extensively diseased one yet found. Hemorrhage of the uterus was slight, but continued for one hour.

October 11, 1923. Cow was eating well, was not straining, and only a small amount of a serosanious discharge was being expelled.

Result of agglutination tests of cow's blood positive for *Bacterium abortus* infection.

Results of agglutination test of calf's blood negative for *Bacterium abortus* infection.

October 12, 1923. Animal was eating well. No evidence of straining or discomfort. Uterus was irrigated with a normal saline solution and 2 to 3 liters of a thin reddish-brown discharge was removed. The discharge was not malodorous. Uterus had good muscle tone.

October 13, 1923. Appetite remained good. Temperature was normal. Discharge from uterus not so copious. No straining. No alteration of feces.

October 15, 1923. Feed of all kind was refused. Temperature 104 degrees F. Uterine discharge was reddish brown in color and contained shreds of placenta. Uterus was irrigated with mild therapogen solution. Tincture of nux vomica and intestinal antiseptics were given per orum.

October 17, 1923. Appetite was normal. Animal was not straining. There was no evidence of diarrhea, and the temperature was normal.

October 20, 1923. Cow was gaining rapidly in flesh and milk production, discharge from uterus consisted of thick, gray, and slightly malodorous pus. The cervical canal was partially dilated and the external cervical folds were hypertrophic. The uterus was enlarged, still flaccid, but there was evidence of contraction when massage was applied. There was a corpus luteum in the left ovary. There were no signs of infection having ascended above the uterus.

October 23, 1923. Vagina, cervix, cervical canal, and uterine cornua were rapidly approaching their normal condition. Discharge from uterus consisted mainly of mucus which contained also a small amount of pus. Muscle tone of the uterus had improved.

October 27, 1923. General condition of patient was good and milk flow had increased. There was a slight discharge of mucopus from uterus, and the uterus had good muscle tone but was still somewhat enlarged.

November 1, 1923. Condition of cow was good, no indications of any disturbances of the udder. A discharge of mucopus from the uterus had continued tho the uterus was near normal in size and position. Condition of cervical canal much improved. Muscle tone of uterus good.

November 6, 1923. With the exception of a slight discharge of cloudy mucus from the cervical canal and uterus, involution was practically completed. The uterus will probably yet undergo further reduction in size, but is apparently normal. No doubt many changes

will take place in the mucous membrane before the animal will again successfully conceive. There was a corpus luteum in the left ovary. The infection did not ascend to the oviducts or ovaries.

On November 21, 1923, a corpus luteum was removed from the left ovary. The cow came in heat and was bred November 23. Estrum again appeared on December 3 when she was again bred. Estrum occurred again on January 11, 1924. On March 6, 1924, she was examined and pronounced pregnant.

CASE NO. 5

This aged cow calved August 16, 1922, and retained a small portion of fetal membranes. Metritis was not extensive or severe, the milk flow was small, appetite capricious, and back slightly arched. Uterus was douched with mild therapogen solution and massaged every third or fourth day. Uterine discharge at first was reddish brown, malodorous, and contained shreds of fetal membranes. Later it became thicker and yellow. Cervix became less inflamed, and muscle tone of uterus improved gradually.

October 25, 1922. A small cyst located in the right ovary was ruptured. A large cystic corpus luteum was removed from the left ovary. Estrum had not yet appeared. Will probably be in estrum within a few days.

October 30, 1922. In estrum and bred same day.

December 21, 1922. Partial prolapse of left vaginal wall existed. Mucous membrane of prolapsed portion was exfoliated. Large cyst in right ovary was ruptured. Cervicitis fairly extensive, other organs normal.

January 17, 1923. Portion of left wall of vagina was removed surgically. The affected wall was badly prolapsed and the mucous membrane excoriated.

January 23, 1923. Cystic corpus luteum removed from right ovary. Vagina showed induration at area of incision.

February 10, 1923. Large corpus luteum removed from left ovary. Uterus normal. A small amount of mucopus removed from the cervix. Area of operation in vagina rapidly improving.

February 14, 1923. In estrum and bred.

March 26, 1923. Examined and found pregnant in right cornu.

September 21, 1923. This animal was noticed to be ill and it was thought she was showing symptoms of an approaching abortion, and an examination of the vagina and cervix revealed the presence of reddish brown mucus and blood. Cervical canal permitted entrance of two fingers. Could not feel fetal membranes or fetus. Rectal

examination indicated that uterus was empty, altho only a small portion of the uterus could be palpated. There were no signs of straining or restlessness. There was loss of appetite. Temperature elevated 2 degrees F. We believed that the fetus had been expelled in pasture.

On September 22, a thin reddish brown discharge had appeared. This was offensive. Cow still refused feed and remained down almost continuously. Examination of vagina and cervix showed these organs still unchanged. Attempted to explore and if possible douch the uterus, but failed. Attached forceps to cervix and by way of the rectum attempted to palpate the uterus, but this did not show indications that the fetus was still present. Stimulants were given, and on September 23 the uterine discharge was more copious and very offensive. A diarrhea was present at this time. A vaginal examination revealed a partially dilated cervical canal, and the presence of the fetal sacs. These were broken and after the fluids had escaped, the head of the fetus was located. The forelegs were completely retained. This condition was corrected and the fetus was finally removed by vigorous traction. It was found to be emphysematous. Odor very offensive and penetrating. Uterus was douched with mild solution of therapogen.

September 24, 1923. Fetal membranes extended beyond the vulva and were very putrid. These were removed, but not in their entirety. The uterus was irrigated and stimulants administered. Appetite better and condition of bowels improved.

September 25, 1923. Cow greatly improved. Appetite good, bowel passages normal, uterine discharge still profuse, but less offensive. Uterus irrigated with mild solution of therapogen. Temperature normal. Sample of blood secured for agglutination test.

September 28, 1923. Result of agglutination test of blood positive for *Bacterium abortus* infection.

September 30, 1923. Condition of patient unchanged.

October 1, 1923. Improving rather slowly. Appetite fair. Temperature normal. No evidence that infection will terminate fatally.

October 3, 1923. Had developed infection in one quarter of the udder. Milk was ropy and blood-stained. Appetite fair and patient was gaining in weight. Discharge from uterus thick and grayish-white. Uterus had fairly good muscle tone.

October 5, 1923. Condition showed slight improvement.

October 8, 1923. Mastitis was quite severe. Intestinal antiseptics and tincture of nux vomica were given. Hot applications were applied to udder. Animal was gaining in flesh. Uterus was receding quite rapidly, and discharge was thick and contained mucus.

October 10, 1923. Uterus had contracted so that it was as small as the non-gravid organ. Cervix was indurated and canal was dilated. Ovaries and oviducts were normal. There was a corpus luteum in the left ovary. Vagina was normal. This cow will be released from quarantine in approximately ten days.

October 13, 1923. Cervicitis quite extensive. Left uterine cornu about normal in size, but right uterine cornu enlarged to twice its normal size, and contained eight or ten ounces of thick gray mucopus which was malodorous.

The uterus was massaged and after the pus was removed was irrigated with normal saline solution. Patient was taken out of quarantine and placed on pasture twenty-two days after parturition.

October 19, 1923. Vaginitis still acute but less extensive. External cervix was hypertrophied. Canal permitted without any difficulty the passage of a horse catheter. Mucopus in small quantities present in cervical canal and vagina. Uterus had contracted markedly and had good muscle tone, but was still slightly enlarged. By rectal palpation, small elevations probably cotyledons, could be detected. A small amount of creamy pus was removed by irrigation. Corpus luteum present in left ovary. Condition of udder had gradually improved.

October 29, 1923. A slight discharge of mucopus from the uterus persisted. Cervicitis was pronounced, and the canal was partially dilated, the left uterine cornu was slightly distended, elongated, and flaccid. Corpus luteum in left ovary was removed.

November 1, 1923. Uterus was contracted and had improved muscle tone. The uterine discharge consisted of clear mucus. The ovary from which the corpus luteum was removed was healing and showed no evidence of becoming infected.

November 3, 1923. Cow was in estrum. The discharge was clear and consisted of pure mucus. The uterus was normal in size and position and muscle tone. The wound in the left ovary had been repaired. External folds of the cervix were hypertrophied, but the canal was apparently near normal. Only one small abscess, in left uterine cornu, could be detected.

CASE NO. 6

Holstein cow calved September 7, 1922. Did not retain the fetal membranes. Appetite unimpaired. No rise in temperature. Milk flow good. Uterus douched only once with normal saline solution. Massage applied immediately after. No other treatment.

On October 25, 1922, the corpus luteum had entirely disappeared, left cornu of uterus normal, right cornu somewhat enlarged and

elongated. The presence of pus was suspected but none could be massaged away. Cervix good. Fluid in vagina suggested estrum.

October 31, 1922. Uterus still somewhat enlarged but had better muscle tone. More mucus in uterine discharge.

November 9, 1922. A cyst was found in the right ovary. Left ovary was normal. Right uterine cornu was half again as large as normal, and slightly flaccid. Cervix about normal. Cyst in right ovary was ruptured.

November 15, 1922. In estrum but not bred.

November 20, 1922. Condition practically normal. Heat fluid present in vagina.

November 28, 1922. Clear fluid in vagina. Corpus luteum in right ovary was not disturbed.

Abscess in the cervical region resulting from injections of living abortion bacilli for vaccination was evacuated. This abscess was large, being 10 cm. at greatest diameter.

December 13, 1922. In heat but not bred.

December 15, 1922. Heat fluid in vagina. No corpus luteum. All organs normal.

December 21, 1922. Corpus luteum in left ovary. All other organs normal.

January 23, 1923. Corpus luteum removed from left ovary. It was recommended that this cow be bred as soon as estrum occurred.

January 25, 1923. In season and bred.

March 26, 1923. Cow was pregnant, fertilization having taken place in right uterine tube.

Gave birth to normal full-time bull calf on November 4, 1923. Fetal membranes expelled four hours later. The blood of this cow reacted positively for *Bacterium abortus* infection by both the complement fixation and agglutination tests.

CASE NO. 7

Cow calved September 12, 1922. Did not retain the fetal membranes. Appetite normal, also temperature. September 15, metritis became severe and she was placed on treatment which consisted of uterine douches and massage. Responded rapidly to treatment. September 19, involution progressed quite rapidly. Corpus luteum was disappearing. On September 20, uterine discharge consisted mainly of mucus, right uterine cornu was about normal, left uterine cornu was slightly larger than normal and elongated. Muscle tone good. On October 25, all organs were found normal and the corpus luteum had entirely disappeared. Contractions of uterus upon massage suggested

that estrum was near. The blood of this cow was positive for *Bacterium abortus* infection by both the agglutination and complement fixation tests.

October 26, 1922. In estrum and bred.

January 8, 1923. Pregnant in left uterine horn. The left ovary contains corpus luteum of pregnancy.

August 3, 1923. Gave birth to normal full-time heifer calf. Fetal membranes were not retained, being expelled four hours after parturition.

CASE NO. 8

Cow gave birth to twin heifer calves, one being black and white, the other red and white. The red and white one, which was born last, was dead. The fetal membranes were partly retained, and most of these were removed manually on November 6, 1922, which was the day parturition occurred.

November 7, 1922. Remains of fetal membranes removed and uterus irrigated with a mild solution of therapogen. Muscular contractions of the uterus strong. The remaining calf died on this date and upon autopsy the true stomach was found to be greatly distended, and filled with undigested curds of milk. Lungs showed small areas of petechial hemorrhages and slight oedema near the region of the heart.

November 9, 1922. The uterus was gradually undergoing involution. Cervicitis not severe.

November 15, 1922. Uterus was irrigated with salt solution and gently massaged. Appetite was capricious and metritis very severe.

November 17, 1922. Uterus irrigated thoroly with salt solution. Metritis still quite severe and shreds of placenta were washed away. The cervix was gradually improving. Left uterine cornu and ovary were readily palpated. No corpus luteum in left ovary. Evidence obtained on palpation indicated both fetuses had been in right uterine horn.

November 18, 1922. The uterine discharge was less profuse, pus was grayish-brown in color and less malodorous. Muscle tone of uterus was improved, but involution was delayed. Left ovary was normal. A corpus luteum was present in the right ovary. Cervicitis was less severe.

November 20, 1922. General improvement was noted, both ovaries were palpated, but no evidence of disease could be found.

November 28, 1922. General improvement very noticeable, appetite good, and milk flow increased. The corpus luteum had disappeared from the right ovary. The left ovary was normal. The left

uterine horn was near normal. Right uterine horn size of sausage, elongated, but muscle tone excellent. The uterus contained a small amount of pus which consisted partly of placental shreds and tissue debris. The cervix and cervical canal were much improved. The uterus was irrigated with a normal salt solution and then massaged.

January 4, 1923. Cervicitis was mild; a small amount of mucopus was obtained by massaging the uterus, the muscle tone of which was strong. Left ovary and oviduct normal. Right ovary contained large corpus luteum which was removed by pressure per vagina.

January 6, 1923. In estrum but not bred.

January 30, 1923. A newly formed corpus luteum was removed from the left ovary. All other organs were apparently normal. Estrum occurred on February 2, when she was bred.

February 27, 1923. Approximately one month after service we found a large corpus luteum, 2 cm. in diameter, in the left ovary. The cervical canal was partly open and there was an abundance of clear mucus in the cervical canal and vagina. Uterus when massaged contracted vigorously, suggesting that estrum was near. Estrum did not occur, and when examined on March 23, 1923, she was pronounced pregnant. This case was somewhat unusual in that the findings under date of February 27 indicated that fertilization had not been successful.

April 13, 1923. There was a large corpus luteum in the left ovary. Both uterine cornu were elongated, enlarged, and had good muscle tone. There were marked constrictions in left uterine cornu. She was slaughtered on this date.

AUTOPSY FINDINGS

This animal proved to be pregnant and the corpus luteum was located in the left ovary. Remains of two old corpora lutea which had been expelled surgically were found free in folds of the mesentery. They were gray in color, flattened, and soft. The blood was positive to the serological tests used in determining the presence of *Bacterium abortus* infection.

CASE NO. 9

Hereford cow gave birth to strong vigorous calf on November 16, 1922. Fetal membranes were not retained.

November 17, 1922. Cervical canal almost closed. Could insert only one finger. An abundance of mucus was found in the vagina. Uterus was involuting rapidly and had good muscle tone. A small corpus luteum in the right ovary was rapidly disappearing.

November 20, 1922. Improvement quite noticeable. Apex of right uterine horn was enlarged and firm to the touch. A corpus luteum existed in right ovary. No adhesions found. Cervical canal almost closed.

November 29, 1922. Corpus luteum in right ovary could still be determined. Involution approximately completed. Muscle tone of the uterus was good, and there was a slight discharge of clear mucus. Cervix normal. Involution in this case was quite rapid. At no time had she shown evidence of infection.

December 2, 1922. A remnant of the corpus luteum persisted in the left ovary. This structure was cystic, but was not ruptured. The left ovary and the oviducts were normal. Uterus could be placed in the palm of the hand. Involution was completed and there was an abundance of clear mucus in vagina. Cervical canal fairly well closed and free from inflammatory changes.

December 7, 1922. The cystic corpus luteum in right ovary was ruptured. All other organs were normal. The blood of this animal was negative to both serological tests for *Bacterium abortus* infection.

December 15, 1922. Heat fluid was now present in vagina. Ovaries and other organs were normal. Will be ready to breed at next estral period.

December 20, 1922. Estrum appeared and cow was bred. Was rebred on January 11, 1923.

February 15, 1923. This cow was examined and found to be pregnant.

November 1, 1923. Pregnancy terminated when she again calved successfully. The fetal membranes were expelled within four hours after calving. Involution was rapid and estrum appeared on December 1, 1923. She was served and conception resulted. A diagnosis of pregnancy was made on February 2, 1924.

CASE NO. 10

Jersey heifer gave birth to a healthy, vigorous calf on December 11, 1922. The fetal membranes were discharged two hours following parturition. December 12, 1922, examination showed that remnants of the uterine seal were still present. The cervical canal was almost closed. There was an abundance of clear stringy mucus in vagina. The muscle tone of the uterus was good, the muscular contractions being very noticeable following massage. Both uterine cornua were still enlarged four or five times. There was a corpus luteum in right ovary.

December 21, 1922. Improvement in general was rapid. The remains of a corpus luteum were located in left ovary. Uterus enlarged to twice normal size and a brownish colored mucus discharged following massage. The cervix and cervical canal were near normal. Muscle tone of uterus was normal, contractions being vigorous and rapid when massaged.

January 8, 1923. A cystic corpus luteum was removed from left ovary, but the well known signs of estrum did not develop.

January 26, 1923. A corpus luteum in the right ovary was evidence that this heifer had been in season but passed by unobserved. All other organs were normal.

January 29, 1923. Came in estrum, but was not bred.

February 21, 1923. Small cyst in right ovary, 1 cm. in diameter, was broken.

March 2, 1923. Remnant of corpus luteum was removed from right ovary and a small cyst, 8 mm. in diameter, in left ovary was broken.

March 6, 1923. Small cyst, 1 cm. A corpus luteum was removed from the right ovary. Cervix and cervical canal were normal. Fluid in vagina suggested estrum.

Blood of this cow subjected to the serological tests gave positive results for *Bacterium abortus* infection.

April 18, 1923. Corpus luteum removed from left ovary. Small cyst, approximately 1 by 1.5 cm., in right ovary was broken.

May 3, 1923. Came in season and was bred.

July 3, 1923. Cow was examined and a diagnosis of pregnancy was made.

CASE NO. 11

Angus heifer aborted. The fetus was approximately 5 months in gestation. December 14, 1922. Blood reaction to serological tests was positive for *Bacterium abortus* infection.

Was examined on December 15, and the fetal membranes had not been expelled, the attachments were very firm. Cervical canal was almost closed, the muscle tone of the uterus was normal, and the muscular contractions were pronounced upon massage. A large portion of the fetal membranes was removed and the uterus was douched with a saline solution. Very little of the mucus plug was attached to the cervical canal.

December 16, 1922. Remnants of a corpus luteum in each ovary. Uterus was contracting rapidly, and muscle tone was normal. Remnants of placenta and tissue debris were removed by irrigation and massage.

December 21, 1922. Uterine contents greatly diminished, not malodorous, and large quantities of clear mucus were being discharged. Applied massage to ovaries and uterus. Uterus possessed normal muscle tone.

January 10, 1923. Bred.

February 15, 1923. Examined for pregnancy. Diagnosis, possibly pregnant.

March 31, 1923. Estrum appeared and cow was rebred. She proved to be not in calf.

April 25, 1923. Estrum occurred and she was again rebred.

June 22, 1923. There was cessation of estrum on account of a retained corpus luteum. She was examined for pregnancy and found not to be pregnant. The corpus luteum in the left ovary was removed. Estrum occurred on June 24, when she was bred. On August 15, was pronounced to be in calf. This pregnancy terminated February 27, 1924. Calf was premature but was active and vigorous. Fetal membranes were expelled promptly but placental necrosis was extensive. Smears prepared from the placenta revealed the presence of organisms which were believed to be *Bacterium abortus*.

CASE NO. 12

This was a purebred cow affected with mummification of the fetus. The dessicated fetus was located in the right uterine cornu. The left ovary was enlarged and slightly cystic. A corpus luteum in the right ovary was located. Fetus was about the size of a cat and the cow was within two weeks of termination of her gestation period. The corpus luteum was removed by pressure per vagina. On the second and third days following the operation the cow was bellowing and acting as though she had calved. An examination on the third day revealed the presence of the fetus engaged in the vagina and cervical canal. The fetus and genital tract were very dry and some traction was necessary for its removal. Three weeks later the uterus and all other organs were apparently normal, muscle tone of the uterus was normal, and clear mucus in the vagina suggested estrum. Estrum appeared and the cow was bred twenty-five days after the operation.

January 6, 1923. Corpus luteum in left ovary. All organs were apparently normal.

January 19, 1923. Cow had passed over one heat period.

March 10, 1923. Examined for pregnancy. Diagnosis, pregnant.

September 7, 1923. Animal aborted and retained the fetal membranes. Sample of her blood subjected to the agglutination test was positive for *Bacterium abortus* infection.

February 22, 1924. Again in calf.

CASE NO. 13

Parturition occurred on December 20, 1922. Fetal membranes were expelled three hours later. Examined December 21, 1922, and involution was found to be progressing rapidly.

December 29, 1922. General condition much improved. Muscle tone of uterus normal. No cervicitis. Corpus luteum still present. Uterus approximately normal in size and position.

January 17, 1923. With the exception of a small cyst, approximately 1 cm. in diameter, in left ovary, which was ruptured, all other organs were apparently normal. The blood was positive to the serological tests employed in determining the presence of *Bacterium abortus* infection.

January 24, 1923. In season and bred.

February 14, 1923. In season and bred.

March 8, 1923. In season and bred.

April 1, 1923. In season and again bred.

June 22, 1923. Examination showed that the animal was now pregnant.

CASE NO. 14

Cow was delivered of a large bull calf on December 27, 1922. The animal was suffering with uterine inertia and while the cervical canal was dilated and the fetus was in normal position, no effort was being made to expel it. Two mils of pituitrin was given subcutaneously at the noon hour. At 1:00 p.m. there was some evidence of labor, but she made only slight progress. We then applied traction and secured a big strong calf. Fetal membranes were tightly attached. Fetal membranes were not retained, having been expelled six hours later. All four legs of the cow were edematous before parturition and remained filled for forty-eight hours following calving. The cow was constipated, with complete loss of appetite and elevation of temperature to 106 degrees F. Metritis was apparently mild. Saline purgative given, also potassium acetate in capsule. Tonics and intestinal antiseptics (creolin and mucoseptone) were also given.

January 2, 1923. Metritis and cervicitis mild, chocolate brown discharge from the uterus upon the application of massage. Corpus luteum had disappeared. Both horns of uterus were enlarged five or six times the normal non-gravid size. Temperature was normal, appetite had improved, and milk flow was gradually increasing.

January 4, 1923. Uterus contracting slowly. Left ovary enlarged. Its greatest diameter was 9 or 10 cm. Was possibly in process of abscess formation. Oviduct was adherent and enlarged. Cervicitis existed in mild form. Uterus was douched with normal saline solution. Appetite was normal, milk flow had increased, and temperature was normal.

January 13, 1923. Left ovary and oviduct almost normal in size. The corpus luteum had disappeared. Left uterine cornu had good

muscle tone and was near normal in size. Right uterine cornu was still enlarged about three times its normal size, and the walls were flaccid and showed lack of muscle tone. Four or five necrosed maternal cotyledons were removed by irrigation and five ounces of thick grayish mucopus was also removed. The cervix and cervical canal were near normal.

January 17, 1923. A small amount of mucopus in the vagina, and inflammation of cervix less severe. The muscle tone of left uterine cornu was near normal, right uterine cornu was enlarged and distended with pus, which was not malodorous. Cervical canal was very tortuous, making the passing of a catheter very difficult. Irrigations and massage of the uterus brought forth one half liter of mucopus. Corpus luteum had become absorbed.

January 19, 1923. Cow showed marked improvement. Uterus now had good muscle tone and was less flaccid, but was still discharging a small quantity of mucopus. Uterus irrigated and massaged. Cervicitis less severe. Pus removed from uterus was thick, grayish yellow and mixed with mucus.

January 23, 1923. Uterus was still flaccid but had better tone. A small amount of mucopus was obtained upon massage and one degenerated maternal cotyledon was expelled. The cervix was inflamed and the canal was difficult to follow. Small cyst in right ovary was ruptured, left ovary was probably free of cysts or lutein tissue. Uterus was massaged and irrigated with mild solution of therapogen.

January 26, 1923. The cervix remained unchanged. Yellowish-gray pus mixed with mucus was obtained upon massage and irrigation of the uterus. The uterus was flaccid, had poor muscle tone, and contracted only slightly when massaged. A small cyst in the left ovary was ruptured. Serological tests positive for *Bacterium abortus* infection.

January 31, 1923. Cervicitis was less severe. The left uterine cornu was still flaccid with poor muscle tone. Two ounces of thin grayish offensive pus was secured upon massage. A small cyst, 1.5 centimeters in diameter, in left ovary was broken. No evidence of lutein tissue in either ovary. Uterus was irrigated with hot saline solution and massaged vigorously.

February 5, 1923. Cervicitis now very mild. Very little pus found upon massaging uterus. Ovaries and uterine tubes normal.

February 16, 1923. Involution completed. Uterus was free of pus and all organs were apparently normal in position, size, and contour.

February 27, 1923. Animal was killed and found free of gross changes or alterations of the reproductive organs. Cultures from the various organs remained sterile.

AUTOPSY FINDINGS

The wall of the right cornu was 8 mm. thick, while the wall of the left cornu was 1 cm. thick. The cervix was 11 cm. long and the mucous membrane appeared normal. The mucous membrane at the beginning of the body of the uterus was reddish brown in color and had the appearance of being hyperaemic, serous surface of cornua congested. The carunculae in left cornu were 2 cm. by 1 cm. Carunculae in right cornu were 8 mm. by 5 mm. The entire mucous membrane of both cornua was reddened and swollen, more pronounced in left than in right cornu. Both ovaries were normal in size and contained in cortical region several follicles of various sizes. The right ovary showed on the surface a small wound containing blood, which indicated that this animal had recently ovulated. The oviducts were normal in size and position.

CASE NO. 15

This cow gave birth to a heifer calf on January 14, 1923. Fetal membranes were expelled within twelve hours.

January 15, 1923. The vagina was found to be injured as tho torn during delivery. Cervical canal was almost closed, but some of the mucous plug of pregnancy was still intact. Uterus had contracted fairly rapidly and possessed good muscle tone. Serological tests were positive for *Bacterium abortus* infection.

January 17, 1923. Right vaginal wall just inside vulva quite badly injured but the wound did not extend into the fibrous coat. A large blood clot filled the wound but it was not interfered with.

January 23, 1923. Lacerated part of vagina showed the beginning of necrosis. Small part of serous coat of rectum adherent to roof of vagina. Uterus was contracting fairly rapidly. Vagina was douched with a hot saline solution.

January 26, 1923. Examination showed vaginitis to be less severe. Small pieces of the vaginal mucous membrane had sloughed away. Manual vaginal and rectal explorations caused pain, which was evidenced by severe straining. Vagina was douched with hot saline solution.

February 5, 1923. Vaginitis and cervicitis were less severe, and corpus luteum had disappeared. The uterus was found to contain a small amount of pus, was massaged and irrigated with a mild solution of therapogen.

February 16, 1923. Animal now in good condition, all organs being apparently normal.

March 5, 1923. Cow was in estrum and bred.

April 6, 1923. A diagnosis of pregnancy was made, she was then slaughtered and found pregnant, conception having occurred in left uterine cornu. Corpus luteum of pregnancy present in left ovary.

CASE NO. 16

A purebred Jersey cow gave birth to a strong and healthy bull calf on January 28, 1923. Calving occurred at 8:30 p.m. Fetal membranes were expelled at 11:45 p.m.

January 29, 1923. The uterus was contracting rapidly and the cervical canal was almost closed. A small portion of the mucus plug was found clinging to the external cervical folds, which were hyperaemic and hypertrophic. Uterine blood vessels were full and pulsating. A corpus luteum was present in the right ovary.

February 10, 1923. Corpus luteum persisted in the right ovary. An abundance of reddish brown mucus was being discharged from the uterus. External portion of cervix was hypertrophic, muscle tone of uterus strong, tho uterus was enlarged 4 to 5 times. The right uterine horn was the larger.

February 2, 1923. Calf became ill with a violent form of white scours.

February 4, 1923. Calf died. Cultures made from the lungs developed a few colonies of *B. coli*. All other tissues cultured proved sterile.

The cow was examined again on February 21, 1923, when a large corpus luteum was found in the right ovary. The cervix was much smaller and almost normal. The uterus was normal in both position and conformation.

Indications were that this cow would suffer delayed estrum unless the corpus luteum rapidly degenerated. Conditions would have justified one in calling this a retained corpus luteum, and it would in all probability have to be removed. Serological tests negative for *Bacterium abortus* infection.

March 26, 1923. The corpus luteum had disappeared from the right ovary, but the symptoms of estrum had not been observed. On April 10, 1923, a newly formed corpus luteum in the left ovary was removed and the herdsman was instructed to watch closely for signs of estrum.

April 14, 1923. In season and bred.

May 23, 1923. A diagnosis of pregnancy was made. Corpus luteum of pregnancy was present in left ovary.

Pregnancy terminated January 23, 1923, when a strong, vigorous, 62-pound calf was born. Fetal membranes were promptly expelled. Parturient paresis developed on January 24, but a good recovery was made. Involution was rapid and the general physical condition was good. Examination on March 1 showed that the estrous cycle had not yet been re-established and that the corpus luteum was retained. Estrum appeared March 3, at which time the animal was bred. The corpus luteum of the recent pregnancy was still retained. This cow is fourteen years of age and has been at University Farm since 1915. During this period she has calved successfully nine times. She has twice been affected with parturient paresis, the first attack occurring in the summer of 1915.

CASE NO. 17

Cow showed signs of abortion on January 28, 1923. Physical examination revealed the presence of amniotic sac engaged in cervical canal and vagina. Cervical canal was well dilated but uterus was more or less inert so far as muscular contractions were concerned. The fetus was presented posteriorily, was edamatous and dropsical. Fetal membranes were filled with gelatinous fluid and two to three inches through. Abdominal cavity of fetus was filled or distended with sero-gelatinous fluid. Stomach contents consisted largely of what was apparently a semi-liquid mucus. The fetus was approximately six to six and one half months in development. The cow was badly shrunken, very thin, and the appetite was capricious. There was a painful swelling of the right front carpal joint. This condition, together with an acute attack of indigestion was first noticed on January 26, 1924.

Examination on January 29, 1923, presented the following symptoms: Temperature normal, inappetance, feces soft and covered with mucus. The animal was gaunt, but not depressed. Was not straining, altho the fetal membranes were still attached. Entire attachment confined to left cornu. Right cornu involuted to the extent that only two fingers could be inserted into the lumen. The cotyledons in the non-gravid horn could not be palpated. In douching the uterus, muscular contractions were stimulated, so that the hand could not be removed until the organ relaxed. A small corpus luteum persisted in left ovary. Cervical canal closing slowly.

Stomach contents of fetus cultured for *B. abortus* Bang and a luxuriant growth was secured in pure culture. Cultures of dropsical fluid remained sterile.

January 31, 1923. Cervical canal was closed to the extent that it would allow the passage of only two fingers. Right cornu was almost back to normal size and the fetal membranes were apparently not attached in non-gravid cornu. Neither were the carunculae markedly enlarged. Fetal membranes were still very firmly attached in left cornu and the muscle tone of this part was very good. Apex of left cornu was turned up along side body of uterus and when palpated was very tense and sensitive. Both ovaries were palpated and there was no sign of a corpus luteum in either ovary. Uterus was irrigated with four gallons of a normal salt solution. Temperature was normal, but the appetite remained poor. Rumination had ceased and the feces were hard and scanty. Laxatives and tonics were administered.

February 1, 1923. Cervical canal was open but would allow the passage of only a small catheter. No evidence of severe cervicitis. Right uterine cornu was almost normal in size and position. Both ovaries were palpated and found to be free of corpora lutea. Muscle tone of uterus was improved and after irrigating with hot saline solution a piece of placenta was secured and with traction aided by massage of the uterus, the fetal membranes were removed. The apex of the left uterine horn was firm and contracted vigorously when massaged. Tonics and laxatives were again given. Temperature was normal. Appetite was more or less capricious.

February 5, 1923. General improvement of animal was noticed. Uterus was massaged and irrigated with normal salt solution. Serological tests were positive for *Bacterium abortus* infection.

February 10, 1923. Animal showed marked improvement. Uterus near normal in size and position. No corpus luteum in either ovary. Cervicitis was less severe. Small amounts of mucopus were being intermittently discharged. Emaciation was pronounced but appetite was greatly improved. Uterus was improving. Two hundred and fifty mils of thick creamy pus was removed from the uterus by massage. The pus was thick, grayish-yellow, and malodorous. Condition of cervicitis was improving, but improvement was slow.

February 19, 1923. A large corpus luteum was removed from the right ovary. This corpus luteum was either deeply situated in the ovary and in this way passed or escaped detection until this date; or the cow ovulated and a new corpus luteum resulted, as is the regular procedure. The latter explanation is probably not correct, but it seems almost impossible repeatedly to mistake or overlook a corpus luteum of that size, even tho it was deeply imbedded. The uterus was near normal in size and position, had fairly good muscle tone, and gave off only a small amount of mucopus upon massage. The cervix was near normal.

March 2, 1923. Two small cysts, approximately 8 mm. in diameter, located in each ovary were broken. The one in the right ovary formed where the corpus luteum was removed on February 19. Cervix was normal. Uterus had good tone, was free of pus formation, and the animal was improving rapidly. She was gaining weight, increasing in milk production, and was eager to exercise.

March 6, 1923. Cervix and cervical canal now normal. Mucus containing particles of pus located in the vagina. There were six cysts, approximately 0.5 to 1.5 centimeters across, located in the ducts of Gärtner. Uterus, ovaries, and tubes were normal. Muscle tone of uterus was good.

March 14, 1923. In season and bred.

April 16, 1923. In season and bred.

June 17, 1923. In season and again bred. On July 30 living abortion vaccine was injected and on September 27 was rebred. On November 15 she was pronounced in calf.

CASE NO. 18

This heifer aborted twin fetuses on March 29, 1923, male and female approximately six months in gestation. Fetal membranes were dropsical and fairly firm at points of attachment. A large portion of fetal envelopes was removed on March 30, 1923, and the uterus was irrigated with normal saline solution.

March 31, 1923. Uterus was again irrigated and a small portion of fetal membranes was removed. Muscle tone of uterus was strong and cervical canal was gradually closing.

April 2, 1923. Uterus was irrigated and gently massaged. Muscle tone was near normal. Uterine discharge was reddish-brown and malodorous. Animal gradually improving, appetite only fair, but there was no straining and the back was not arched. Serological tests were positive for *Bacterium abortus* infection.

April 19, 1923. In estrum. Muscle tone was good. Heat fluid was abundant but contained small particles of pus. Cultures were negative for *Bacterium abortus* Bang. No corpus luteum in either ovary.

May 4, 1923. In estrum and bred.

May 30, 1923. In estrum and bred.

June 15, 1923. Was rebred, after which there was cessation of estrum until September 10, when it again occurred. At this time there was a small cyst in left ovary. The cyst was ruptured and on September 27 she was rebred. Experimental animal inoculated with placental extract was negative to *Bacterium abortus* infection.

November 5, 1923. Cow was examined and pronounced pregnant.

CASE NO. 19

A heifer gave birth to a bull calf on June 6, 1923. Presentation anterior. The fore feet extended with lateral deviation of the head. Fetus was removed with considerable traction after presentation was corrected. This calf had prominent goiter. Blood samples were collected from both calf and dam, also a sample of milk and a small portion of placenta. Blood of both cow and calf was negative to serological tests for *Bacterium abortus* infection. The milk as well as the animal inoculated with placental extract was negative for *Bacterium abortus* infection.

June 8, 1923. A portion of the fetal membranes was removed.

June 9, 1923. The vagina was irrigated with mild antiseptic solution. Tonics and intestinal antiseptics given per orum.

June 11, 1923. The vagina was irrigated and tonics and intestinal antiseptics were again given per orum. Pathologic changes now were vaginitis, metritis, and enteritis, the latter being evidenced by profuse diarrhea. There was inappetance and the temperature was elevated to 104 degrees F.

June 12, 1923. Uterus was irrigated with a hot saline solution. Muscular contraction of uterus was more vigorous, altho there was active inflammation of a severe type. A portion of fetal membranes was still retained, and an offensive odor was given off with the uterine discharge. Condition of vagina was improving. Temperature 103 degrees F. Appetite fair, and no further evidence of diarrhea. Tincture of nux vomica and an intestinal antiseptic (creolin) were again given per orum.

June 13, 1923. Vagina irrigated with hot saline solution and uterus gently massaged. Condition of uterus improving. Vagina also improving. No signs of diarrhea. Feces were normal. Appetite fair. Nux vomica and intestinal antiseptics were continued.

June 15, 1923. Paravaginal abscesses, two in number, were located. The one on the right side was approximately 14 by 10 cm., that on the left side, 10 by 6 cm. The contents of abscesses were caseated and the walls were apparently very heavy. Cervicitis severe, uterus flaccid, muscle tone poor with little or no contraction. Contents of uterus were liquid in consistency, reddish brown in color, and gave off a very offensive odor. Involution was seriously delayed. Diarrhea had been controlled. Uterus was massaged but not irrigated. Small portion of fetal membranes still retained and a few of the cotyledons could be palpated.

June 18, 1923. Paravaginal abscesses have receded to one half maximum size attained, and very hard. Uterus contracting fairly rapidly, and the remaining fetal membranes had been expelled.

June 23, 1923. Contraction of uterus continued to be rapid. Uterine discharge consisted mainly of mucus. Cervical canal was near normal. Injuries of the vaginal mucous membrane have been entirely repaired. Abscesses have almost disappared, having terminated in small indurated areas.

June 27, 1923. Posterior third of vagina was constricted as a result of the injured mucous membrane. Cervical canal was apparently normal. The apex of the right cornu was adherent to the oviduct and ovary. These structures were adherent also to the broad ligament and omentum. Both cornua were approximately normal in size and there was no evidence of infection having involved the left ovary and oviduct.

July 3, 1923. Animal was killed and autopsied.

AUTOPSY FINDINGS

The uterus had almost attained its normal non-gravid size and position. The left uterine cornu was still slightly enlarged and elongated. The right cornu was at the apex adherent to broad ligament, oviduct, ovary, and omental fat. Three small abscesses, approximately one cm. in diameter, on dorsal surface of wall of right cornu, and adherent to the muscle below and the fat above. Oviduct contained pus and was partly buried in adhesions. Right ovary was buried and slightly cystic. No corpus luteum in either ovary. No lesions in left ovary. Uterine mucosae slightly reddened and covered with a small amount of mucopus. Carunculae in each cornu were about of equal size, those in left being the larger and more prominent. The left oviduct was normal, there being no evidence of cervicitis. Vaginal mucous membrane normal. Peri-vaginal abscesses small, walled off, and partly surrounded by fat necrosis. The pus in all the abscesses was yellowish-green, pasty, and malodorous. The animal suffered with placentitis and severe injury of the vaginal mucous membrane. The left ovary was normal and showed no signs of lutein tissue.

Results of bacteriologic examination: Abscess involving right ovary and oviduct gave growth of *B. coli communior*. Left ovary and oviduct gave growth of *Staphylococcus pyogenes albus*. Peri- and paravaginal abscesses gave growth of a streptococcus and *B. coli communior*.

SUMMARY

Involution consists of numerous and interesting phenomena, the most important of which is the reduction in size of the uterus. The act of involution offers a barrier to infection, but when sepsis occurs involution is stopped or retarded. The uterus which regresses rapidly in size and possesses normal muscle tone does not readily absorb bacteria or their products. In cows in which the act of parturition is normal and the fetal membranes have been promptly expelled, regression of the uterus as a rule is very rapid. The uterus will in many cases resume its non-gravid position and morphology within 10 days. However, in a large number of cows which have apparently calved normally in every way and which to all appearances do not develop infection, 2 or 3 weeks are frequently required before the uterus is completely reduced.

The entire amount of time required for the completion of the various phenomena of involution varies from 30 to 40 days.

The relation of the corpus luteum to involution is not known, but in certain cases of uterine affection, particularly pyometra, in which involution is retarded or entirely stopped, the early removal of the corpus luteum is followed by vigorous muscular contraction of the uterus, resulting in evacuation of its contents and restored normal function of the reproductive organs.

Retention of the fetal membranes is a serious menace to involution, and not only produces subinvolution, but seriously interferes with the immediate health of the cow and endangers her ability again successfully to reproduce.

Bacterium abortus Bang is capable of producing extensive and severe placentitis with infiltration and oedema of the chorion.

Retardation of involution as a result of sepsis, which may affect not only the uterus but the oviducts and ovaries as well, is usually due to pyogenic bacteria. In these cases suppurative inflammation is not uncommon.

Among the organisms frequently found are the *Bacillus pyogenes,* Staphylococci, Streptococci, *B. coli,* and other pyogenic organisms.

Successful control of bovine infectious abortion will mean a greatly reduced percentage of cases of retained fetal membranes, which in turn will reduce the cases of subinvolution and subsequent disorders of the reproductive organs resulting in either temporary or permanent sterility.

ADDENDA

CASE NO. 1

A second calf was born on September 12, 1923. She was bred 33 days following parturition, and calved again on September 9, 1924. Estrum occurred on October 1, at which time she was bred. Signs of estrum again appeared on October 21, and the cow was rebred. On January 22, 1925, this animal was pronounced as being with calf.

CASE NO. 4

This cow again calved at term on August 26, 1924. Placentitis was severe. The fetal membranes were retained. Only slight areas of necrosis of the placental and interplacental tissues were observed. The inflammatory changes later extended to the serous coat of the uterus, which resulted in loss of appetite, elevation of temperature, and rapid emaciation. Treatment was administered regularly until October 7, 1924, when the patient had recovered. Extensive lesions of the left ovary and oviduct together with numerous adhesions, led us to believe that her fertility would be greatly reduced, if not entirely suspended. The cow was slaughtered on October 30, 1924.

AUTOPSY FINDINGS

Massive adhesions involving the uterus, vagina, bladder, rumen, and omentum. A large abscess involved the left ovary. The left oviduct was buried in adhesions and difficult of recognition. Numerous small abscesses were present in the muscular and serous coats of the uterus. The right ovary was cystic while the right oviduct was apparently normal. The mucous membrane of the uterus was normal. The mucous membrane of the uterine cervix showed the presence of chronic inflammatory changes. This cow was rather remarkable in that she calved successfully three times, tho each gestation was accompanied by extensive placental disease.

CASE NO. 5

This cow reacted to the tuberculin test and was slaughtered November 20, 1923.

CASE NO. 6

This cow is now in calf and is due to freshen in April, 1925.

CASE NO. 7

Cow calved again successfully October 28, 1924. She is at the present writing again with calf.

CASE NO. 9

Parturition again occurred on October 1, 1924, and at the present time she is with calf.

CASE NO. 10

Was sold October, 1923. Cow was pregnant.

CASE NO. 11

This cow gave a positive reaction to the serological tests used in the diagnosis of abortion disease. Involution was completed in approximately twenty days. This animal was considered as being especially dangerous as a spreader, and as her breeding and conformation were not particularly desirable, she was sold for slaughter.

CASE NO. 12

During September, 1924, it was discovered that the fetus had succumbed and was undergoing the process of mummification. Removal of the corpus luteum resulted in expulsion of the dessicated cadaver. Involution progressed in a normal manner and at the present time she is again in calf.

CASE NO. 13

Cow again calved successfully on January 5, 1924. Fetal membranes were expelled promptly. A few months later this cow suffered a severe injury to the left hock joint and was later sold for slaughter.

CASE NO. 16

Parturition occurred again on December 8, 1924. A small portion of the fetal membranes was promptly expelled, but the remaining portion, owing to placentitis, was very firmly attached. Failure to expel the remaining membranes retarded involution, and the inflammatory changes involving the uterine mucosa extended into the muscular and serous coats. The result was inappetance, elevation in temperature, stiffness of gait, and mastitis. Recovery was slow, but estrum occurred in March, 1925, at which time she was considered to be in fair physical condition.

CASE NO. 17

Normal parturition occurred in August, 1924. The fetal membranes were retained and were removed manually 48 hours later. Involution was retarded. Inflammation of the uterus became very extensive and finally was complicated with a severe form of mastitis. Emaciation was progressive and as the entire udder was so extensively involved with inflammatory changes, particularly abscessation, it was deemed advisable to slaughter.

AUTOPSY FINDINGS

The cow was destroyed in November, 1924. The reproductive organs were normal in appearance. The uterus so far as could be determined macroscopically had completed involution. The gland tissue of the udder was markedly atrophied, small areas of necrosis were numerous, and many small abscesses were found in various portions of the udder.

CASE NO. 18

Estrum appeared in March, 1924. A physical examination showed that conception had not resulted from the September service, altho an early abortion may have occurred. Cystic degeneration affecting both ovaries developed soon after the signs of heat and altho treatment was applied at regular and frequent intervals, the patient gradually became a nymphomaniac. She was condemned as incurably sterile and was sold for slaughter.

ACKNOWLEDGMENT

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BIBLIOGRAPHY

1. De Bruin, M. G. Bovine obstetrics. Translated by Wyman, W. E. A. p. 81. Wm. R. Jenkins, N.Y. 1901.
2. Smith, Theobald. Jour. Exp. Med., XXIX, 451. 1919.
3. De Lee, Joseph B. Principles and practice of obstetrics, p. 213. W. B. Saunders Company, Philadelphia. 1918.
4. Smith, F. A manual of veterinary physiology, p. 787. Alex. Eger, Chicago. 1921.

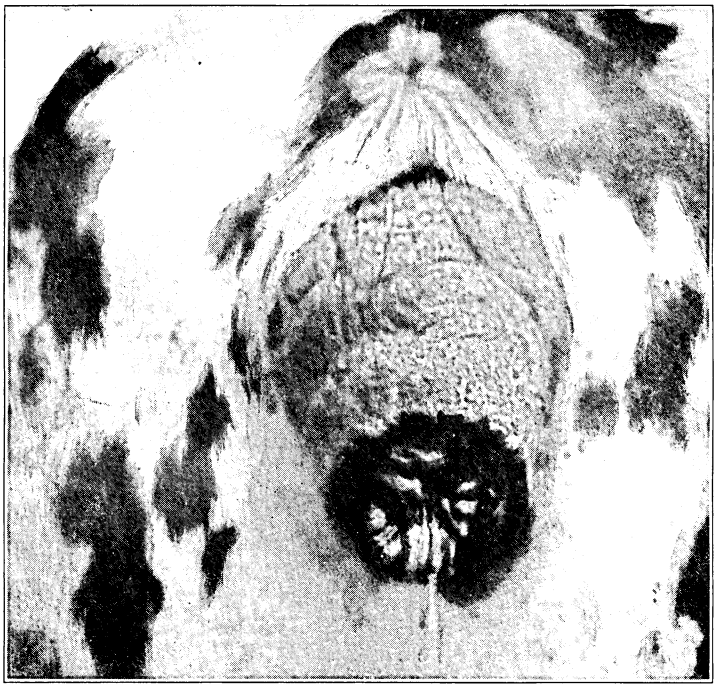

Fig. 1. Prolapse of the Vagina

The hypertrophic folds of the external Os of the cervix are shown in the center. The cervical canal is dilated and a mucus discharge can be seen clinging to the edge of the Os.

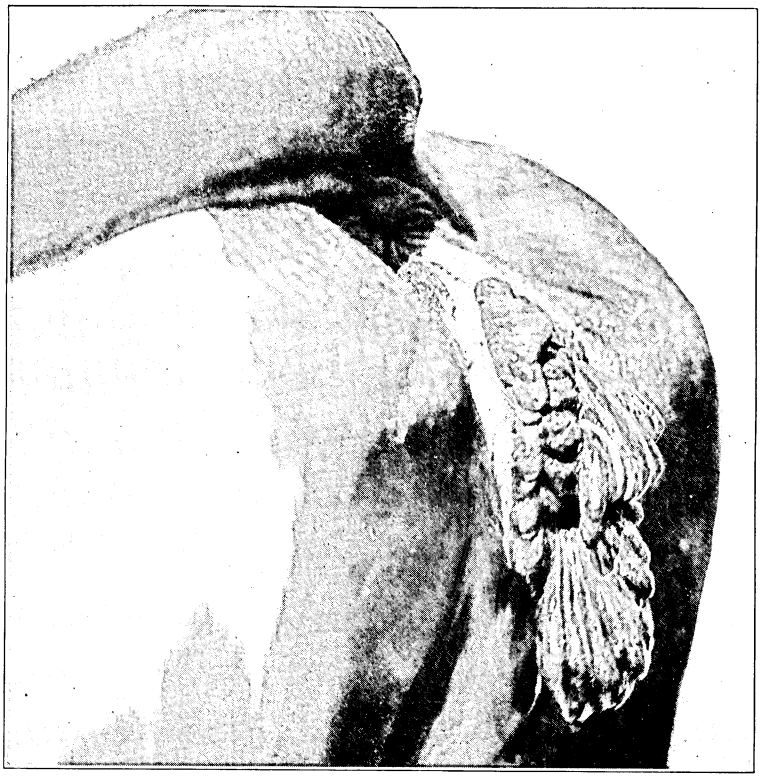

Fig. 2. Chronic Cervicitis

The external Os of the cervix is prolapsed and is markedly hypertrophied. The cervical canal is dilated and there is a copious discharge of mucopus.

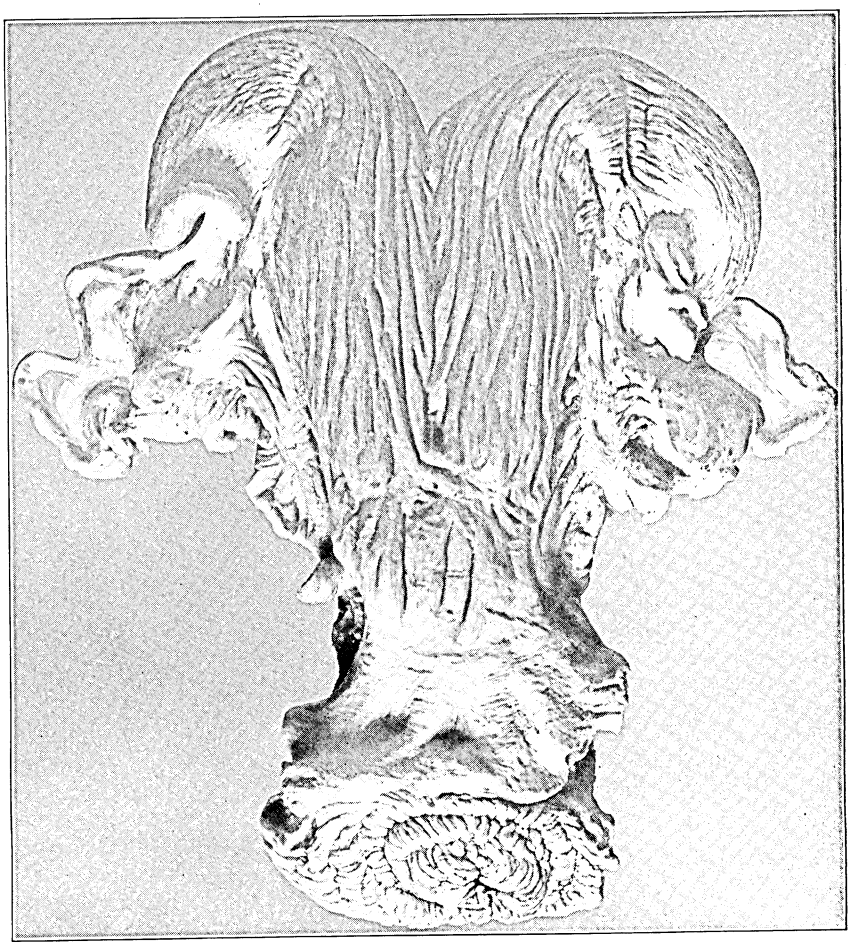

Fig. 3. Uterus Showing Final Stages of Involution

The deep longitudinal furrows of the muscle are clearly shown. A corpus luteum which projects above the surface can be seen in the right ovary.

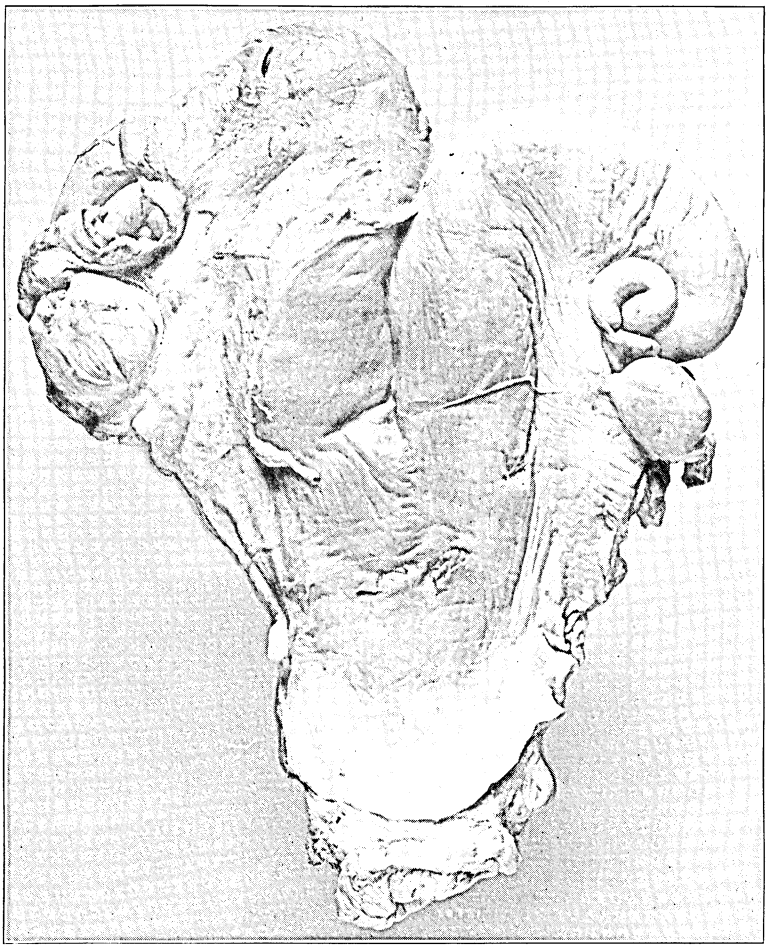

Fig. 4. Acute Metritis of a Severe Type, in Which the Inflammation has Extended to the Muscular and Serous Coats

Extensive adhesions involve the left uterine cornu, tube, and ovary.

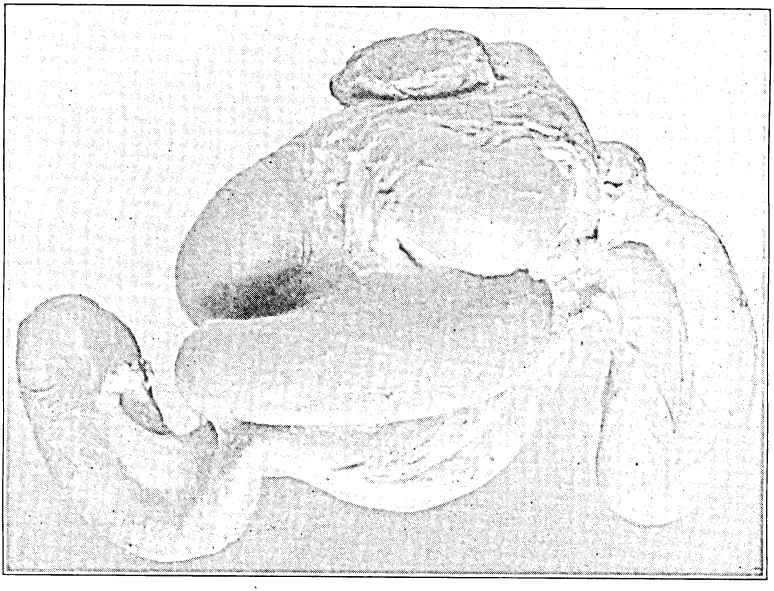

Fig. 5. Uterine Tube or Oviduct Showing Condition Known as Hydrosalpinx

This is the result of an acute inflammatory process, which is characterized by pus formation. The pus is absorbed and replaced by a clear watery straw-colored fluid. The tube is enlarged, very tortuous, and thin-walled. Adhesions are extensive.

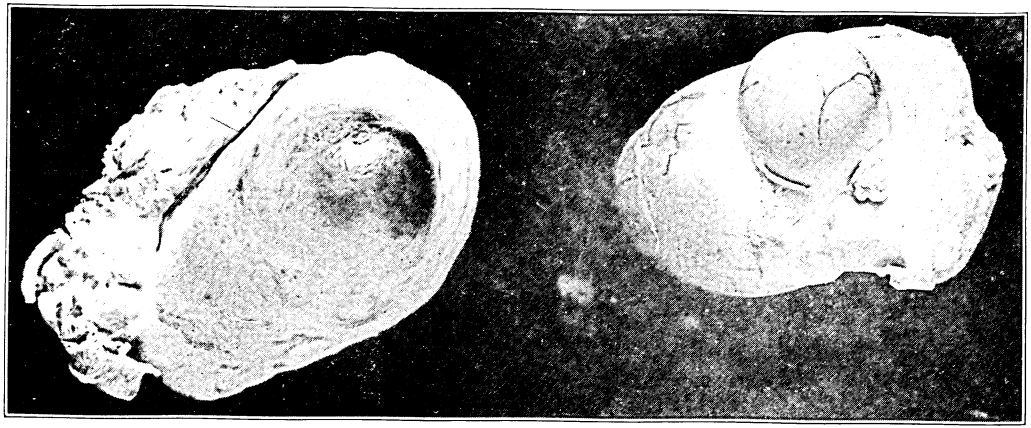

Fig. 6. Ovaries Showing Presence of Corpora Lutea

The ovary on the right shows two yellow bodies both of which project above the surface. Small blood vessels on the surface of these structures are plainly shown.

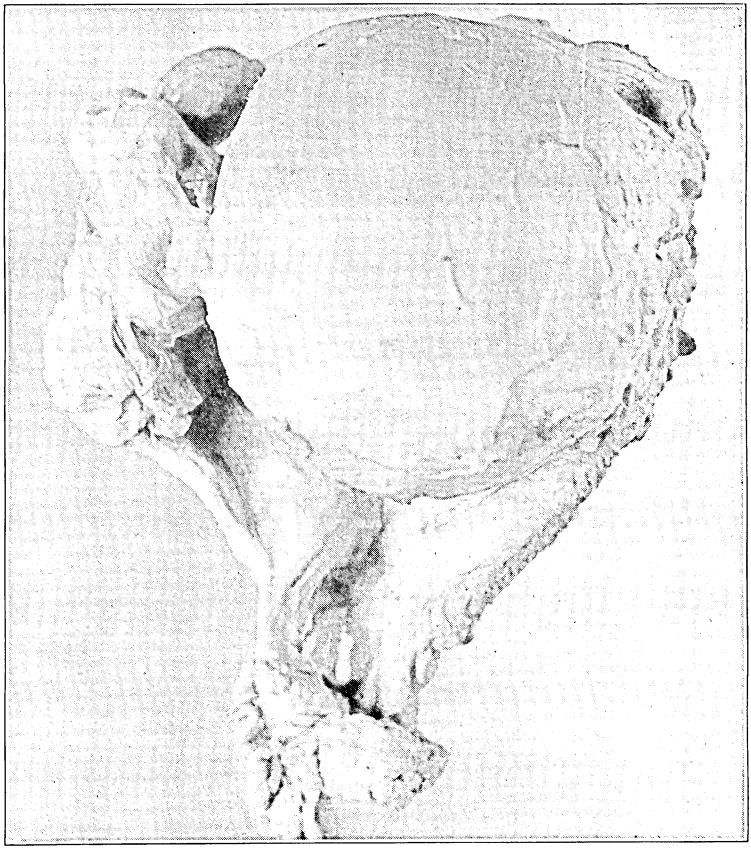

Fig. 7. Ovary and Oviduct Affected with Suppurative Inflammation

The ovary has been converted into a large abscess. The abscess wall is not especially thick but is more dense than the wall of the ovary which is cystic. Massive adhesions have obscured the greater part of the oviduct.

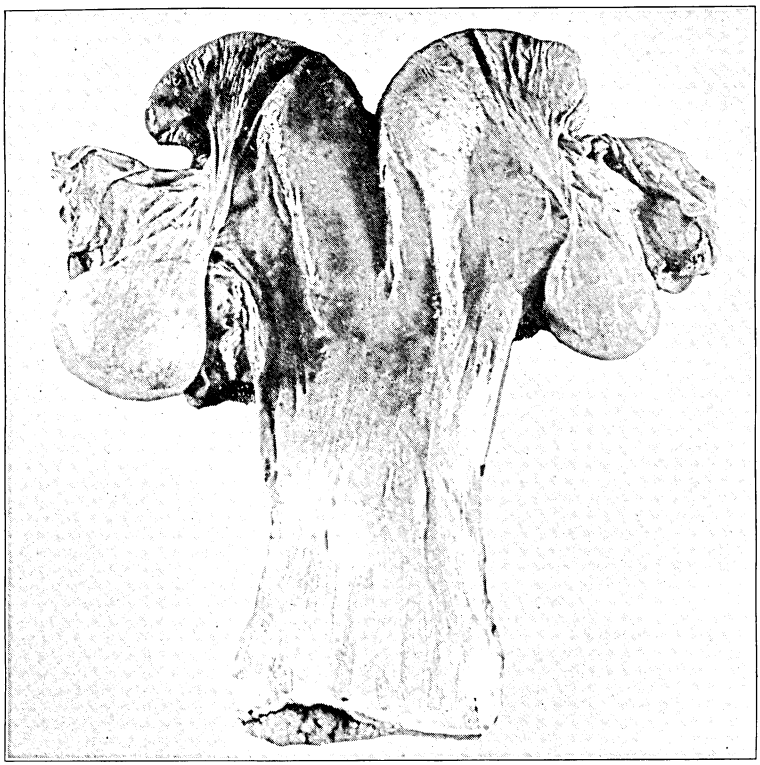

Fig. 8. Genital Organs, Showing Presence of Inflammation of Uterus and Cystic Degeneration of the Ovaries

The ovaries are greatly enlarged and contain a clear watery fluid. The ovarian walls are thin and as a rule can be easily ruptured.